




Engineering in human Health

Seenivasagam R

Editor-in-chief, Indian Journal of Engineering

General Note

 Article is recommended to print as color digital version in recycled paper.

1. INTRODUCTION

Engineering is a practical application of scientific & mathematical principles to design, build and analyze objects. It is a broad term that covers a wide range of applications and industries. The major branches are: Mechanical, Chemical, Civil, Electrical, Management, and Geotechnical, and literally hundreds of different subcategories of engineering under each branch. Engineering turns science and technology into something tangible and useful to society. It is applied in home appliances and other infrastructures and equipment, which make human lives safe and convenient. Engineers are creative both as initiators and implementers of new ideas. They invent new technologies and highly successful in creating the complex technical systems that make modern life possible [1]. They have created technical systems that have transformed society and the environment. Their creativity is often understated and unrecognized. They should depend on the established science and methods for analysis to ensure their designs are safe and reliable.

2. VARIOUS BRANCHES OF ENGINEERING & ITS APPLICATIONS

Mechanical Engineering systems assist industries such as: manufacturing, aeronautics, nanotechnology, nuclear power production, heating and cooling.

Aerospace Engineering involves in the study of air and space travel which include military aircraft design and development, along with commercial airline design and satellite technology.

Biomedical engineering combines the study of medicine and biology and applies their design skills to biological and medical sciences especially in healthcare treatment technology. They develop and maintain diagnostic devices such as EEGs, MRIs, and other imaging machines. Physicians use these machines to diagnose their patients' medical problems.

Biomechanical Engineering is the study of organisms and mechanics which helps in environmental challenges such as waste control and keeping our waterways free from pollution. It shares close ties with Biomedical Engineering and Agricultural Engineering.

Automotive engineering involves the design and production of vehicles which work in areas such as mechanical design, performance, manufacturing, electrical engineering and systems management.

Civil Engineering involves the development of infrastructure such as buildings, railways, roads construction, bridges and general construction project management. Environmental Engineering, Structural Engineering and Marine Engineering are also comes under Civil Engineering.

Architectural engineers work in the construction, planning, and design phase of projects which includes: Heating, Ventilation, Air Conditioning, Electrical, Fire protection, Lighting, Plumbing and other systems specific to earthquakes and hurricanes have special consideration.

Electrical Engineering involves the study of energy available in various forms such as electrical, hydro and natural sources such as wind and solar energy. It also involve in designing components for electronic equipment, communications systems, power grids, automobiles, and many more.

Computer Engineering involved in the design of integrated hardware and software solutions for technical problems. It involves Telecommunications, Networking, Software Application Development, or Manufacturing, and additional industries are emerging, such as Application Development, Web Development, Network Security / Cyber security, and Cloud Computing. Most industries rely on information technology.

Electronics engineering mainly involves in designing and building electronic equipment such as circuits, switchboards, and other electronic configurations to design and build these devices.

Mechatronics or Mechatronics Engineering is an emerging area for hybrid engineers. It is a blend of mechanical engineering and electronics engineering. Nearly all mechanical equipments are operated with a mix of electronics and software based on computers and technology. Mechatronics engineers have intrinsic knowledge of electrical, electronics, and mechanical engineering. They also have computer, hardware, and software engineering experience as well.

Robotics engineering focus on automation and the use of machines to assist with repetitive tasks such as those found in manufacturing. Robotics engineers will typically design robotic technology and develop maintenance systems to help achieve optimal efficiency [2].

Microelectronics comes under Electrical Engineering with a focus on the word 'Micro'. Microelectronic Engineers specialize in the development and design of small electrical devices such as mobile phones, desktop computers etc., also used in a wide range of industrial applications.

Chemical Engineering is the practical application of chemistry. It involves technology that utilizes chemical reactions to solve problems. Chemical engineers create new products, including: Cosmetics, foods, pharmaceuticals, beverages, and cleaners from raw chemicals.

Environmental Engineering involves the study of science and engineering to improve our environment which includes the air we breathe, food we consume, and water. Environmental Engineers role is to study the environmental impact of humans including pollution as a result of development and manufacturing processes. It is a subset of Civil Engineering.

Materials Science engineering is a study of materials includes plastics, ceramics and polymers. Everything around us is made up of materials, as we evolve there is an increasing demand for materials which are stronger, more environmentally friendly and lighter.

Agricultural engineering involves the application of engineering to the agricultural industry to assist with area of farming including: soil conservation and salinity, ground preparation, irrigation, farm machinery design and production and helping develop more effective harvest techniques.

Paper Engineering is a specialization of chemical engineering and involves understanding the processes involved (chemical and mechanical) of paper production, the principles behind molecular science, wood pulping and fluid mechanics etc.

Manufacturing Engineering focuses on manufacturing processes and machinery and quality control systems. This is a very broad discipline with diverse areas of engineering such as: Material science, manufacturing technology and automation (robotics) along with fluid mechanics and hydraulics.

Petroleum engineering involves the extraction of oil and gas from beneath the earth. Petroleum engineers play a significant role in locating reservoirs beneath the earth's surface for gas and oil companies.

Geological engineering involves engineering and research skills for mining and construction projects. Geological engineers assess ground conditions and other natural hazards (earthquakes, etc.) before starting construction.

Marine engineering assist to the development of ocean technologies which include fixed and floating structures, such as pontoons and jetties, propulsion and power generation for boats, ships and other marine transportation.

Nanotechnology is the study of extremely small elements such as molecules and single atoms and the production of extremely small devices. Nanotechnology is expected to be as important to us as the industrial revolution over time as it has the potential to help solve some of the world's major problems including health and environmental concerns. It is a very specialized discipline that can be applied to a very broad range of industries and fields.

A mining Engineering involves studying the extraction of mined resources from the earth in a safe, economical and environmentally responsible manner. Engineers involved in the mining industry areas are: machinery production and design, mine design, mine construction.

Metallurgical Engineering involves the study of engineering principles to extract and purify metals and other minerals from ore. Metallurgical Engineers develop and design processing techniques and machinery in mineral processing unit.

Geomatics Engineering involves the study of precise measurement for mapping the earth's environment using advanced equipment and techniques. Geomatics Engineers play an important role in planning future infrastructure and often work with large amounts of data to form digital replications of terrain and develop 3D maps. It also includes the study of GPS technology.

3. BIOMEDICAL ENGINEERING IN HUMAN HEALTH

Biomedical engineering is the application of the principles and problem-solving techniques of engineering to biology and medicine. It comprises biology, life sciences, medicine, clinical applications and the improvement of human health. In human health it involved from diagnosis and analysis to treatment and recovery at all levels [3]. Biomedical engineering applications include medical devices, such as pacemakers and artificial hips; tissue and stem cell engineering, 3-D printing of biological organs, orthopedic implants, medical imaging, biomedical signal processing and clinical engineering are influencing the human health.

4. ROBOTICS IN HUMAN HEALTH

Robots become more sophisticated and embedded in our modern lives. This hi-tech robot helps to improve the quality of the elderly & disabled life. In the new era of emerging technology Medical robotics helps in the human health of all individuals. It helps in numerous operations and extensive use of telepresence that are normally performed manually by human beings. Robots reach a tremendous growth from radiation treatment to eye surgery, rehabilitation to hair transplantation, and robot therapists to robotic pharmacists, and even a robot phlebotomist, healthcare robots are transforming the fields of medicine across the globe. Robots reduce soft tissue damage, promote faster healing, and allows for complex 3D reconstruction geom tries. This healthcare robot helps hospital staff to decrease the workload and lead a much friendlier environment [4]. Biorobots enable the biologists to understand the complex animal-environment relationships. This biorobotics play an important role for biologists to study the animal behavior.

5. NANOTECHNOLOGY IN HUMAN HEALTH

In nanotechnology, nanomedicines have numerous potential applications to human healthcare. It helps in the treatment of neuro degenerative disorders such as Parkinson's disease, Alzheimer's disease, tuberculosis treatment, in surgery, damaged tissue can be reproduced or repaired, transplantation of organs or artificial implants, antibiotic resistance, immune response etc. Nano- medicine use nano materials and nano electronic biosensors to treat individual atoms, molecules, or compounds into structures to produce materials and devices with special properties [5]. Early detection and prevention, improved diagnosis, proper treatment, implants and regenerative medicine, drug delivery and follow-up of diseases is possible with the help of nano medicine. Nanotechnology has excellent contribution in the field of stem cell research. For the delivery of gene or drugs into stem cells, nano materials such as carbon nano tubes, fluorescent CNTs and fluorescent MNPs have been used. Nano particles are used for site specific drug delivery [6].

6. GENETIC ENGINEERING IN HUMAN HEALTH

Genetic engineering is the genetic makeup of an organism altered by inserting, deleting or changing specific pieces of DNA. It uses different techniques such as transformation and molecular cloning to alter the genes of the humans and changed human life positively. Genes influence health and disease, as well as human traits and behavior. Genetic engineering plays a vital role in the manipulation and duplication of DNA pieces, for industrial, medical and research purposes. Benefits of genetic engineering are realized in production of valuable proteins such as human insulin, interferon, growth hormone etc. Human insulin or Humulin has great importance for the diabetic patients. Interferon is an antiviral agent which is secreted by cells which are attacked by virus [7]. In humans, growth hormone helps in treatment of hypo pituitary dwarfs. Genetically engineered growth hormones may prove useful in the treatment of bone fractures, skin burns and bleeding ulcers of digestive tract. Gene therapy is a technique of genetic engineering used for medical purpose to replace the defective genes with the healthy genes during the genetic and other diseases. Many heart and autoimmune diseases have been treated by using gene therapy. DNA fingerprinting has made it possible to identify criminals in the forensic department. The paternity of the child has also been made possible by using the technique of DNA fingerprinting. Cloning is one of the most important benefits of genetic engineering to clone many organs and tissues for the betterment of human health.

REFERENCE

1. Douglas, Josh; Iversen, Eric; Kalyandurg, Chitra (November 2004), engineering in the K-12 classroom: An analysis of current practices & guidelines for the future (PDF), Washington, D.C.: American Society for Engineering Education, pp. 1–23
2. Robotics: Redefining crime prevention, public safety and security; URL: <https://www.sourcesecurity.com>
3. Discovery and technology for human health. Nature Biomedical Engineering, 1, Article number: 0001 (2017); URL: <https://www.nature.com/articles/s41551-016-0001>
4. Guang-Zhong Yang, James Cambias, Kevin Cleary, Eric Daimler, James Drake, Pierre E. Dupont, Nobuhiko Hata, Peter Kazanzides, Sylvain Martel, Rajni V. Patel, Veronica J. Santos and Russell H. Taylor. Medical robotics—Regulatory, ethical, and legal considerations for increasing levels of autonomy. Science Robotics, 2017, Vol. 2, Issue 4, eaam8638; DOI: 10.1126/scirobotics.aam8638
5. Saini, Rajiv; Saini, Santosh; Sharma, Sugandha (2010). "Nanotechnology: The Future Medicine". *Journal of Cutaneous and Aesthetic Surgery*. 3 (1): 32–33.
6. Wang Z, Ruan J, Cui D (2009) Advances and prospect of nanotechnology in stem cells. *Nanoscale Res Lett* 4: 593–605.
1. Nicholl, Desmond S. T. (2008-05-29). *An Introduction to Genetic Engineering*. Cambridge University Press. p. 34. ISBN 9781139471787.